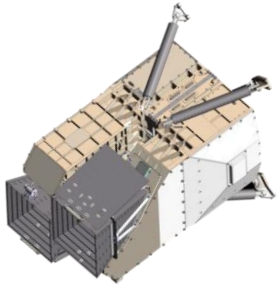
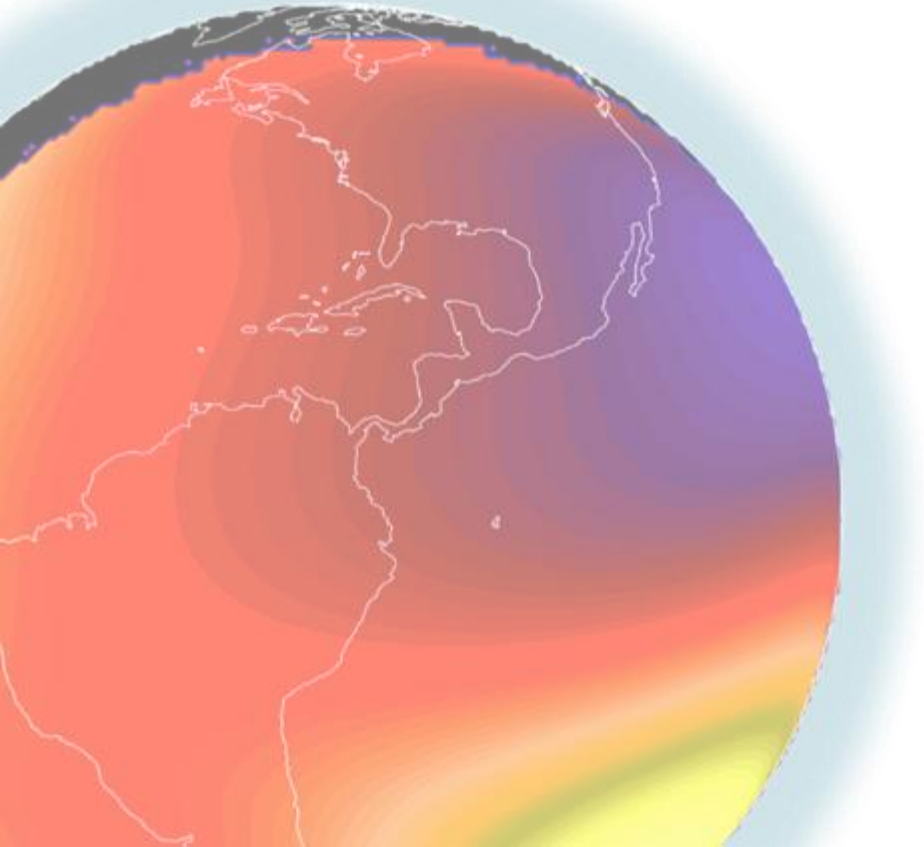
Imaging the Boundary Between Earth and Space – A Preview of Space Weather Data from the Global-scale Observations of the Limb and Disk (GOLD) Mission





Richard Eastes (UCF/FSI),
William McClintock (CU/LASP),
Alan Burns (NCAR) and
the GOLD Science Team

NASA

UCF

LASP

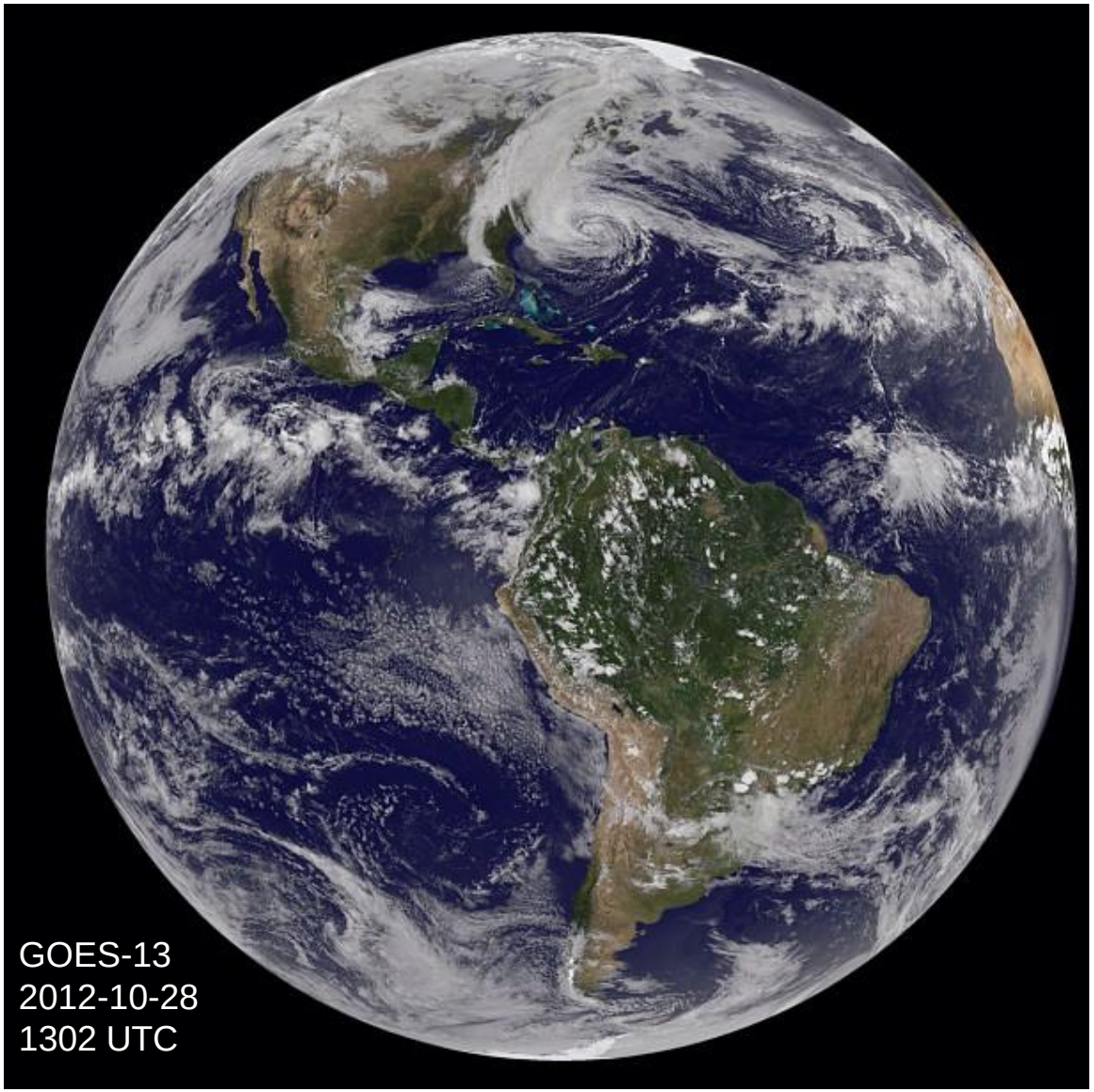
SES Government Solutions

The View from Geostationary Orbit

GOLD will make unprecedented images of neutral temperature and composition in the upper atmosphere's

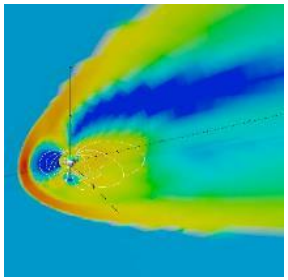
GOLD images the disk and limb from geostationary orbit

Full disk images at 30-minute cadence

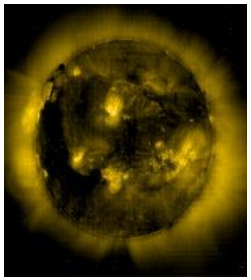


Weather in the Thermosphere-Ionosphere

Forcing from Above



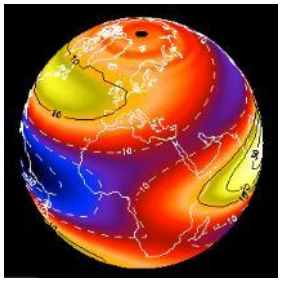
Science Question 1 (Q1). How do geomagnetic storms alter the temperature and composition structure of the thermosphere?



Q2. What is the global-scale response of the thermosphere to solar extreme-ultraviolet variability?

Q4. How does the nighttime equatorial ionosphere influence the formation and evolution of equatorial plasma density irregularities?

Q3. How significant are the effects of atmospheric waves and tides propagating from below on thermospheric temperature structure?



Forcing from Below

Ultraviolet Imaging from Geostationary Orbit

Simulated GOLD image of oxygen (135.6 nm) emissions

Simultaneously images N_2 emissions on dayside

Emissions provide key data for bubbles, satellite drag, and electron densities

Provides data to advance predictions of assimilation models and of geomagnetic storm effects

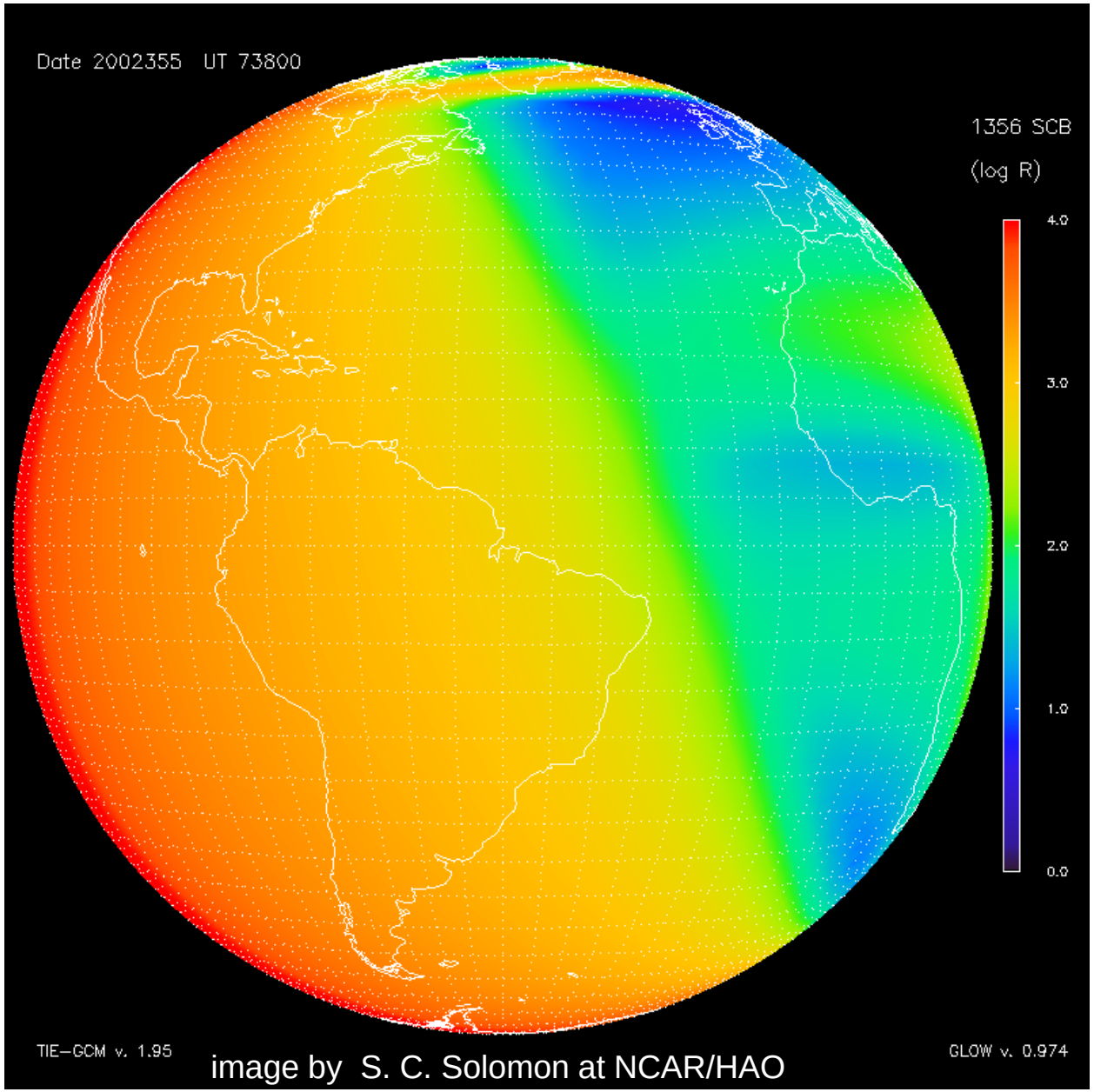
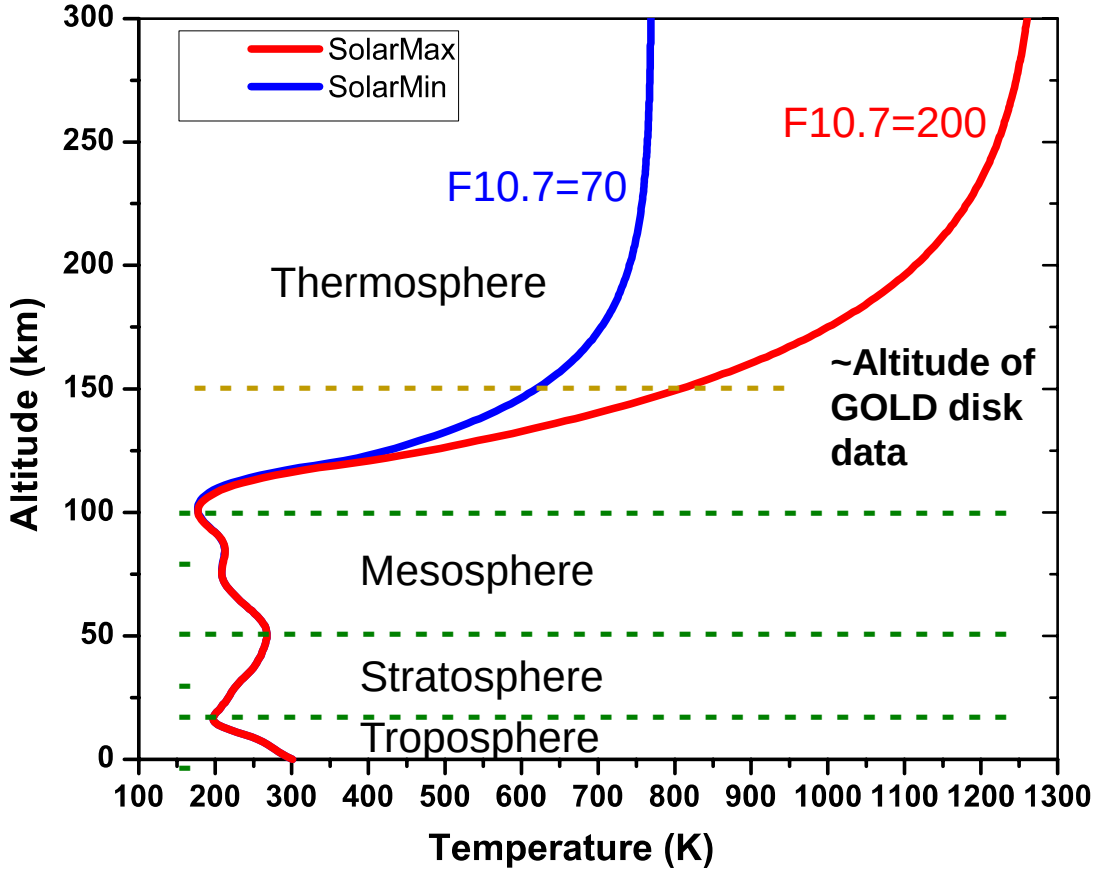


image by S. C. Solomon at NCAR/HAO

Solar Forcing of Thermosphere

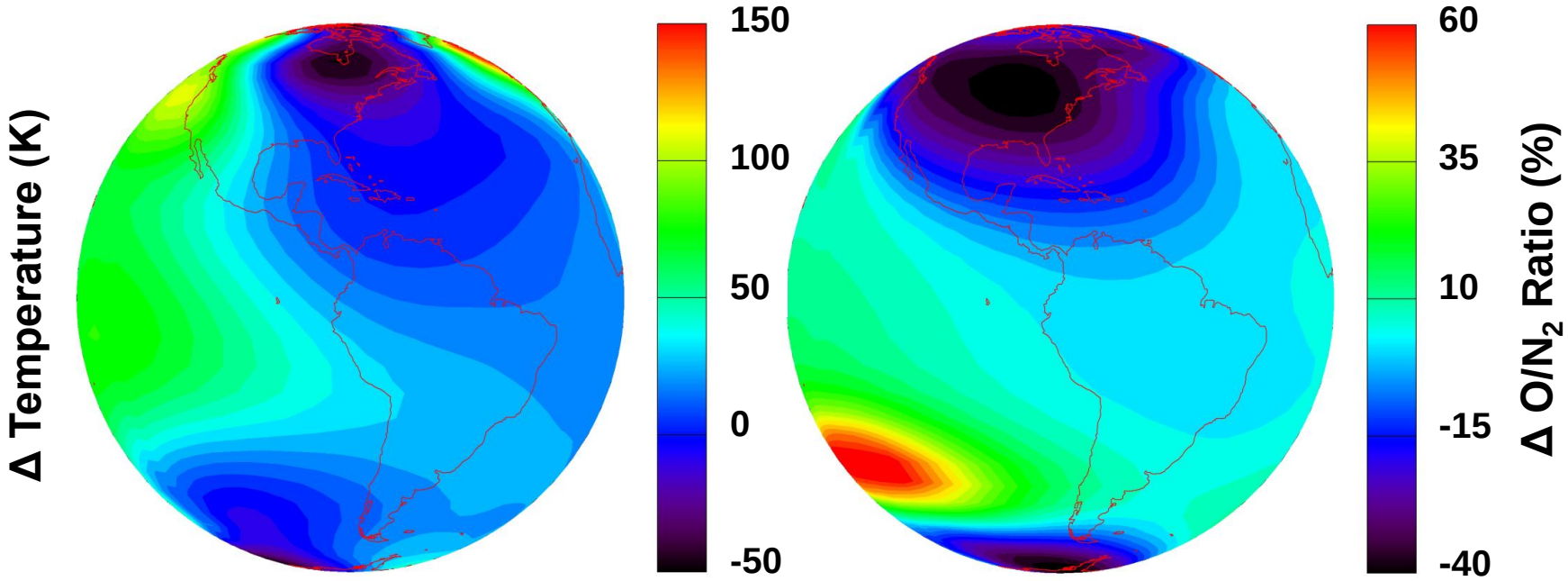
Thermospheric Neutral Temperatures from MSIS Model



GOLD simultaneously images key parameters - temperature and composition (O/N_2) - in lower thermosphere on the dayside disk

Geomagnetic Forcing of the Thermosphere

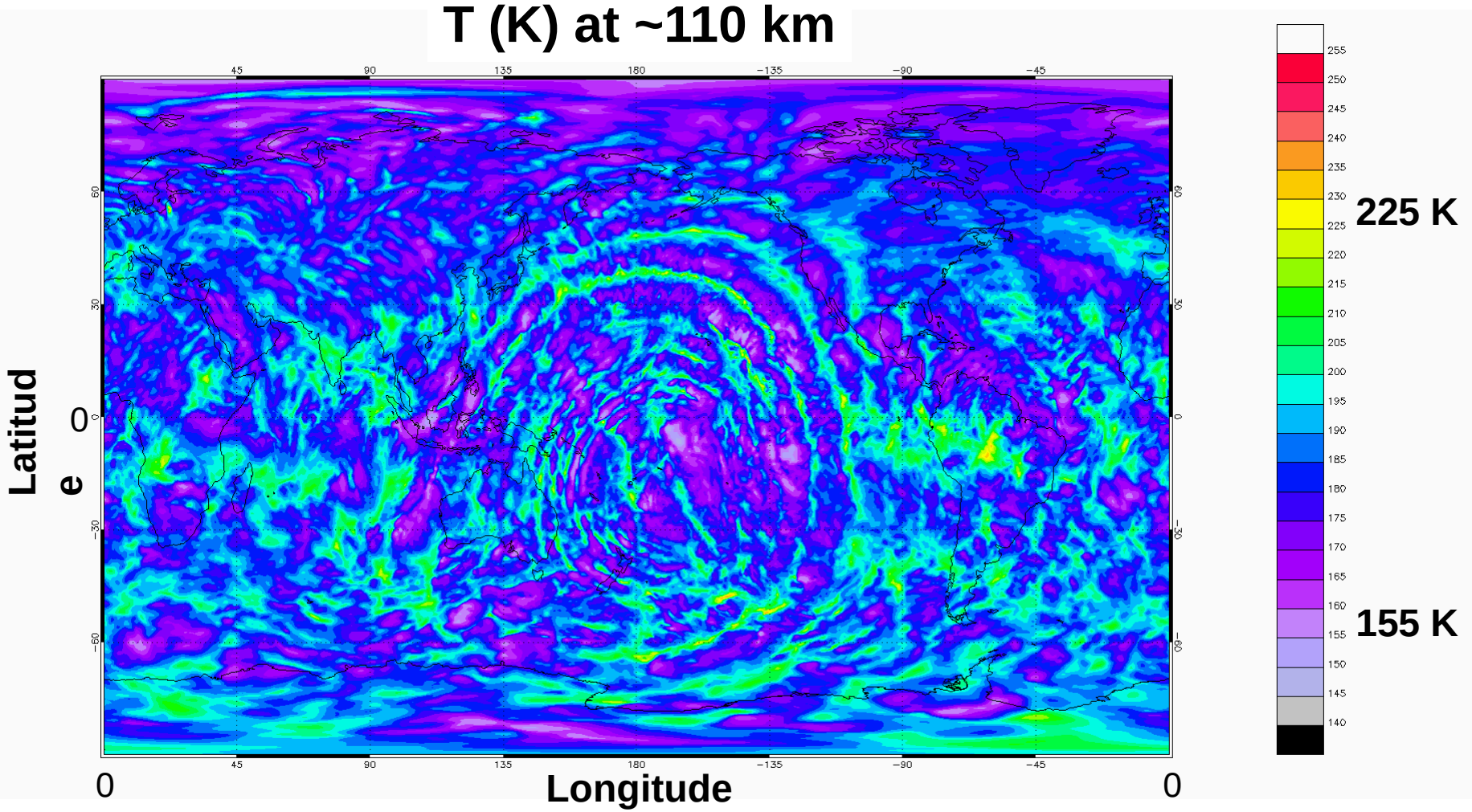
How do geomagnetic storms impact Earth's space environment?



Modeled changes in upper atmosphere during storm

GOLD will discover how the upper atmosphere acts as a weather system

Forcing from Below During Typhoon



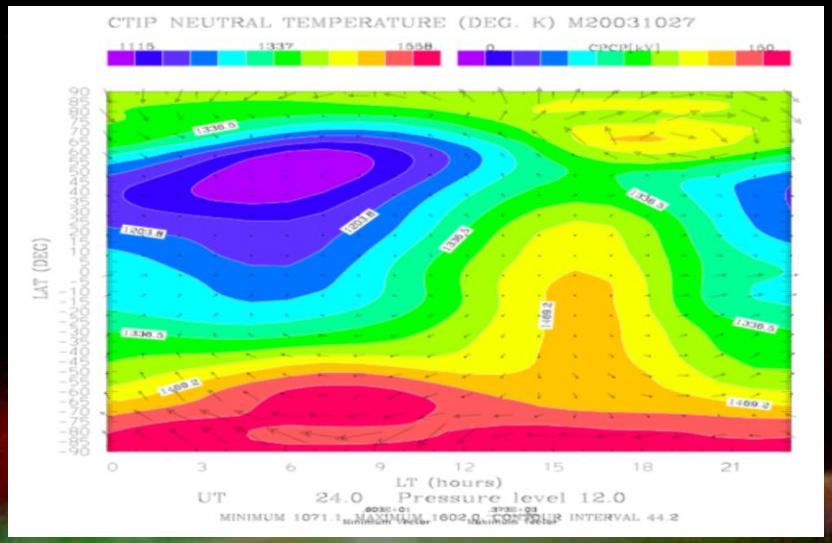
WACCM Calculation of Gravity Waves at High Resolution (0.25° Spatial by 0.1 Scale Height)

From: Hanli Liu at NCAR/HAO

With and Without Lower Atmosphere:

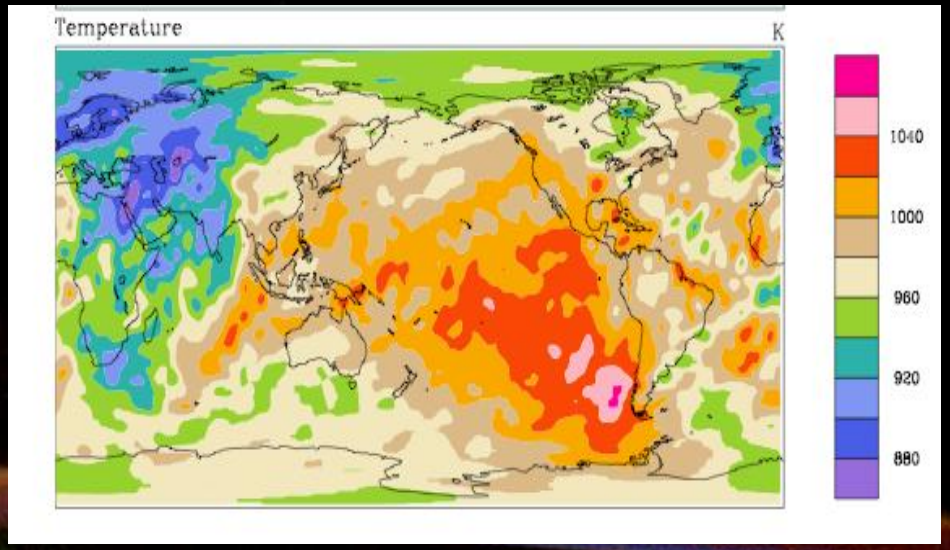
Typical iono-thermosphere model:

- **Driven by Solar EUV and Geomagnetic Storms.**
- **Global maps show little fine structure**



Ionosphere-thermosphere model coupled to the lower atmosphere: Global maps show structure relevant to

- **GPS accuracy and availability**
- **HF Comm.**

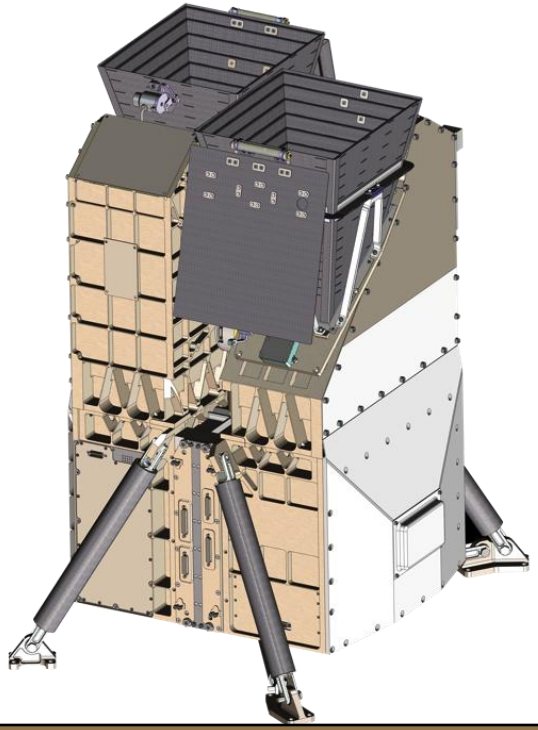


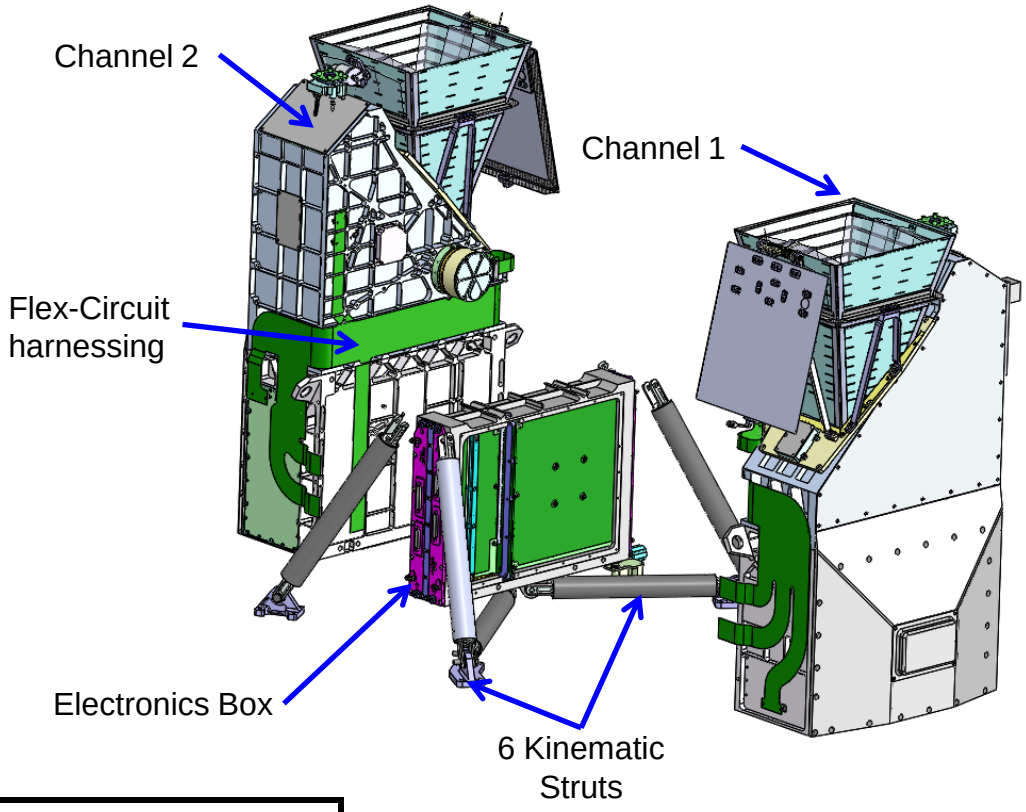
The temperature structure from a stand-alone thermosphere ionosphere plasmasphere model (e.g., CTIPe) is similar to the MSIS empirical model. The Whole Atmosphere Model (WAM) drives variability from the chaotic lower atmosphere which introduces a whole spectrum of variability.

R. Viereck/NOAA

GOLD Mission Instrument

- Imaging Spectrograph: Two independent, identical channels imaging the limb and disk, and a single processor packaged in one housing
- Wavelength range: 132 – 160 nm
- Detectors: Microchannel plate, 2-D crossed delay line anode



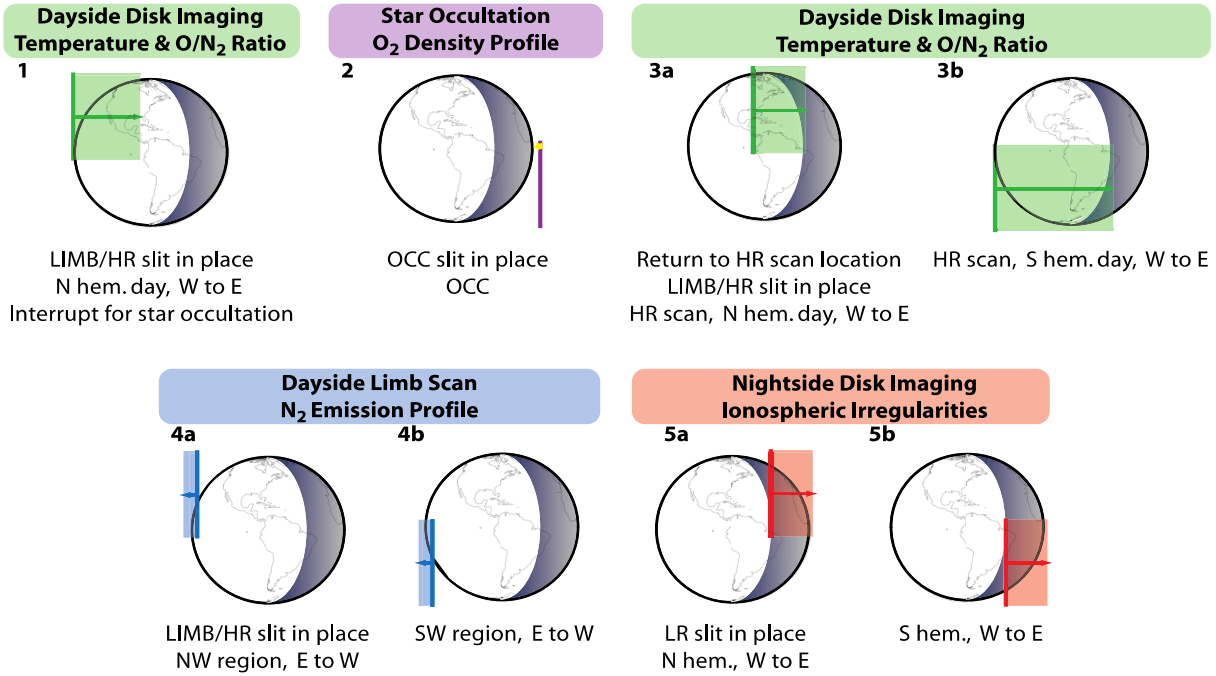


Instrument Summary	
Mass	**33 kg (CBE)**
Power	**51 W (CBE, AVG)**
Size	**51 × 55 × 69 cm^3**

Instrument sensitivity is a factor of ~2 better than at CSR due to updated design.

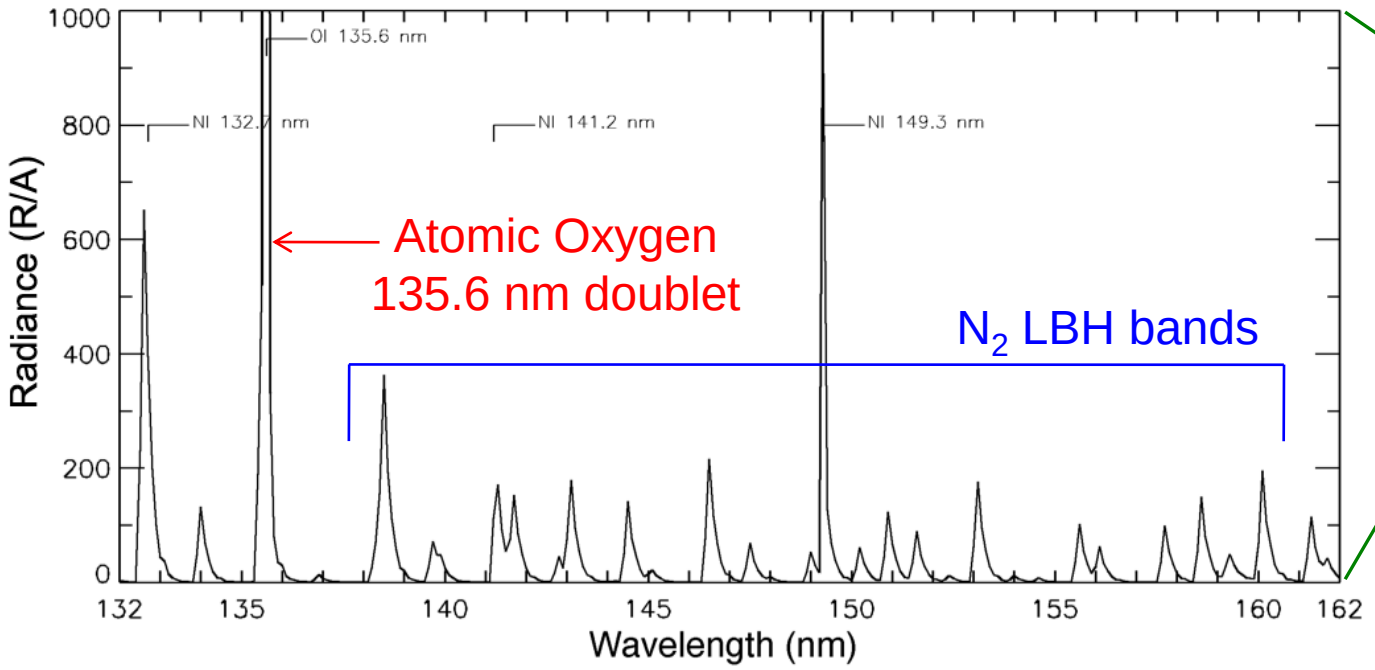
GOLD's Observing Scenario and Data Products

- **Full disk images and limb scans with 30 minute cadence**
  - **Dayside data products: Disk Temperature, Disk O/N_2, OI and N_2 emission brightness, T_{EXO}, Q_{EUV}**
  - **Nightside products: Disk OI brightness, crest locations, N_{max}**
- **Occultation measurements**
  - **Dayside and nightside products: O_2 density profile**



Proven Measurement Techniques

Daytime Far-Ultraviolet Spectrum

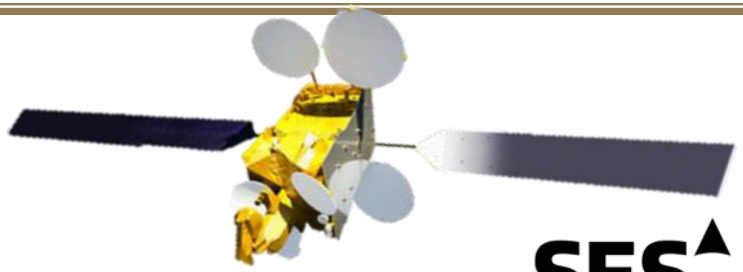


Horizontal scan of disk & limb; image along vertical slit

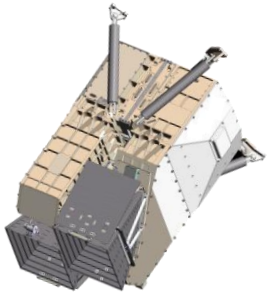
- **Temperature obtained on disk from rotational shape of N_2 LBH bands**
- **O/N_2 composition measured using ratio of 135.6 doublet to LBH bands**
- **Temperature on limb determined by slope of emission altitude profile**
- **O^+ at night observed using 135.6 recombination emission**
- **O_2 profile on limb from stellar occultations**

GOLD Mission Space Segment

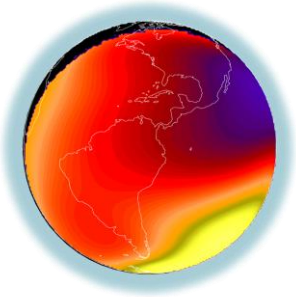
- Host Mission
  - Managed by SES
  - Host Accommodation will be on SES-14
    - GEO commercial communications satellite at 47.5°W, owned and operated by SES
    - Host satellite is a Eurostar 3000 built by Airbus Defence & Space
- GOLD Mission Instrument
  - Hosted Payload is an ultraviolet imager developed by UCF/LASP
  - 6 Mbit/s data down-link
- Data processing at UCF



SES Government Solutions



LASP



UCF

GOLD Mission Summary & Status

- Launches in 2017 for a two-year mission
- Unprecedented, simultaneous imaging of composition and temperature
- Able to separate changes in time from changes in location
- Capability for continuous, real time data availability is inherent to the mission
- Provides context for ground-based and LEO measurements
- Coincident with ground based and LEO missions, ICON
- Mission confirmed on March 5
- Spacecraft accommodation contract has been signed